

## CLIMATOLOGICAL DATA FOR APRIL, 1912.

## DISTRICT No. 10, GREAT BASIN.

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## GENERAL SUMMARY.

This month will long be remembered as one of the coldest of its name ever experienced in this district. The mean temperature averaged considerably below normal and much lower than the average for April, 1911. The cold weather was quite uniform throughout the month, there being no periods of high or exceptionally low temperatures.

Frosts occurred frequently, but owing to the backward condition of the fruit, the losses were small and local, as far as can be estimated at this time.

Precipitation for the district averaged about 30 per cent above normal. There were about eight rainy days on the average, and the excess of cloudy days kept the ground wet.

In general the inclement weather and wetness of the ground were unfavorable for the advancement of farm work and the seasonable growth of all vegetation; but, on the other hand, the continued cold kept the fruit buds from swelling, thus rendering them able to withstand the frosts that occurred during the month. At the close of the month the fruit was just coming into blossom.

## TEMPERATURE.

The mean monthly temperature for the district was 42.6°, or 4.2° below normal, and the individual means ranged from 32.4° at Park City, Utah, and at Tahoe, Cal., to 51.0° at Jean, Nev. The temperature chart shows that the highest monthly mean temperatures occurred, as a rule, in the protected valleys of the Utah area and the southern portion of the Nevada area, and the lowest at the more elevated stations.

Practically every station in the district reported temperatures below normal. The greatest minus departure was at Beowawe, Nev., where the mean was 39.8°, or 9.5° below normal.

The weather was moderately warm during the first week of the month, but after that it was uniformly cool, the lower temperatures beginning about the 6th in the Utah area and about the 9th in the Nevada area.

The lowest minimum temperature was 3° at Pinto, Utah, on the 13th, and the following are the lowest readings reported from other States in this district: 9° at Cokeville, Wyo., on the 1st and other dates; 20° at Grace, Idaho, on the 7th; 13° at Tahoe, Cal., on the 12th; and 11° at Millett and Potts, Nev., on the 12th.

As a rule, the highest temperatures occurred during the first decade; 62° was registered at Evanston, Wyo., on the 14th; 71° at Weston, Idaho, on the 8th; 81° at Iosepa, Utah, on the 10th, which was the highest in the district; 62° at Truckee, Cal., on the 8th; and 79° at Jean, Nev., on the 8th and other dates.

The greatest daily range was 53° at Quinn River Ranch, Nev., on the 2d, when the maximum was 74° and the minimum was 21°. The greatest local monthly range was 60° at Pinto, Utah.

## PRECIPITATION.

Precipitation averaged 1.64 inches for the district, which is 0.45 inch above the normal. The precipitation chart shows a very uneven distribution of moisture throughout the district, the larger amounts occurring on the western slope of the Wasatch Mountains in Utah, in the southern portion of the Nevada area, and in the east-central part of the California area. When the precipitation amounts are studied with reference to the normal amounts inequalities are again very apparent. Amounts above normal occurred almost without exception in the Utah area, while in other portions of the district there were wide deviations from the normal, both above and below.

Precipitation occurred, as a rule, during the last two decades, but there were quite general showers in all parts of the district on the 5th. The heaviest rains for the district centered around the 11th and 19th, and in the California area generally heavy rains occurred also around the 25th and 29th.

The largest monthly amount was 7.32 inches at Deer Park, Cal.; the least was 0.08 inch at Lemay, Utah.

## MORE SNOW MEASUREMENTS.

The activity of the local office of the Weather Bureau at Salt Lake City in measuring the water equivalent of the snow in Maple Creek Canyon, Utah, for two seasons has led at least two others to attempt like work.

Mr. B. F. Eliason, of Moroni, Utah, measured the snow in a small watershed in the vicinity of Moroni, and the city engineer of Salt Lake City also made quite a complete snow survey of Big Cottonwood watershed. Mr. Sylvester Q. Cannon, assistant city engineer, was in charge of the work under the supervision of the city engineer and has kindly prepared a report which appears in another part of this Review.

## DOES FROST FIGHTING PAY IN UTAH?

By J. CECIL ALTER, Observer, U. S. Weather Bureau.

Notwithstanding all the evidence that has been brought forth to show that it pays to fight frost with fire in the Utah orchards, the fact remains that probably more than 90 per cent of the fruit growers of the State are not yet convinced that it pays, and therefore are not utilizing this means of insurance.

Hoping to adduce some new evidence for use in answer to this great question, a little examination has been made of the cost of frost fighting and of the weather conditions in representative Utah fruit regions to ascertain, if possible, whether frost could have been successfully combatted in the past. The general results of the study are given briefly herewith.

The query "What does it cost to heat?" has an exceedingly elusive answer, for not only are facts scarce, but those available present a surprisingly wide range of

values. However, from a number of authoritative sources, material and labor costs have been obtained that seem to present sufficient similarity to warrant taking a mean of them for the purposes of this superficial study.

The oil cost is 6 cents per gallon at the railroad; the coal cost is \$4 per ton at the railroad; orchard heaters, including the pro rata cost of tanks, wagons, and other accessories, have been placed at \$35 per acre as a fixed investment.

Fuel-consumption figures have been gathered from every available source, and for every possible condition. The average of all such values obtained is a little less than 16 cents per acre, per hour, per degree (below 30°), but 18 cents per hour, per acre, per degree has been used for a better margin of safety. Thirty degrees has been used as the "dead line," and the average rate of temperature fall, determined from a number of thermograph records, has been used as 1° fall per hour. Therefore a temperature of 28° is assumed to require 2 hours heating, and a temperature of 26° will require twice as much heat and twice as long.

From all the figures available, the average cost of labor seems to be about 20 cents per hour, per acre. The deterioration of the pots, tanks, and wagons represented in the fixed investment can not reasonably be figured at less than 10 per cent per year, which is \$3.50 per acre; the interest on the money invested, at 6 per cent, is \$2.10 per acre, which is, of course, a legitimate charge against the cost of firing. A safe estimate (in Utah generally) is that one may expect to fire 5 nights each spring, an average of 5 hours per night, or, 25 hours per season. The fixed charges of depreciation and interest divided by 25 hours to reduce it to a usable unit, gives about 22 cents per hour for all degrees of temperature as a fixed charge for firing, in addition to the cash outlay for fuel and labor.

These values, while not perfectly accurate—for no absolutely accurate statement of this nature can be made for obvious reasons—are probably so nearly correct that it has been considered safe to present them to the fruit grower in this connection.

Therefore, orchard heating costs the fruit grower (figured as conservatively as it may be, for perfect safety) 60 cents per acre, per hour, per degree for the first degree; that is, 60 cents per acre per hour for heating from 29° up to the assumed average safety at 30°; but only the labor and fuel increase as the temperature falls lower, the fixed charge of 22 cents remaining the same. However, since in colder weather the orchard heating work is longer and harder, the labor cost has been raised to 22 cents per hour per acre for each additional degree, and this with the 18 cents per hour per acre per degree for fuel makes a constant increase of 40 cents per hour per acre for each additional degree of temperature raise. From this we have the following figures showing the approximate cost per acre for heating:

	Per acre.
29° to 30°.....	\$0. 60
28° to 30°.....	1. 00
27° to 30°.....	1. 40
26° to 30°.....	1. 80
25° to 30°.....	2. 20
24° to 30°.....	2. 60
23° to 30°.....	3. 00
22° to 30°.....	3. 40
21° to 30°.....	3. 80
20° to 30°.....	4. 20

In this computation, when the temperature has fallen below 20°, the heating has arbitrarily been considered

a failure. Also, these figures assume that 90 per cent, or more, of the crop is to be saved for these costs; for in all obtainable cost figures where the statement was made that a certain percentage of the crop was saved, the cost figures have been arbitrarily raised to indicate values corresponding to 100 per cent of the crop saved.

These basic values are slightly higher than the average of those supplied by the manufacturers of heaters, but they have been exceeded occasionally by fruit growers who claim to have exercised a great deal of care and economy in heating; therefore, if the orchardist is calculating the cost of frost insurance, his own personal equation will necessarily enter very largely into the matter; and, in any case, the above cost values are about as low as they can be placed with conservatism from the grower's viewpoint. When the cost has greatly exceeded these values it is highly probable that it was unnecessary, or due to stress of circumstances entirely outside usual legitimate smudging considerations.

However, these chance costs, or accidental increases in the cost, such as delayed fuel shipments, sickness to animals or help, and bad roads, which may not only increase the firing cost, but make firing impossible on a dangerous night, must necessarily enter into the consideration; but just what value is to be placed on them and on the so-called personal equation in handling the work of the man who heats, as a charge into the cost of firing, probably no actuary could calculate from the data obtainable.

The opinion has been expressed that these accidental expenditures have been the cause of much of the apathy of the growers toward the firing question. The business of firing presents so many chances for small leaks that the average farmer is unable to stop them all, it has been claimed. For instance, the waste of fuel in handling, while it is in many cases a considerable quantity, is very small compared with the fuel lost by indiscreetly heating when it is not necessary, due to faulty information from poor thermometers, or to no thermometers at all, or to improperly exposed thermometers; or with the fuel and labor lost by not happening to have pots or fuel sufficient to maintain a safe temperature throughout the cold snap. Again, the firing may, for some unpreventable reason, be delayed so late that the safety temperature can not be regained at a reasonable cost, and losses will result from this source; or there will be too many pots lighted, through lack of experience, and a greater temperature maintained than is necessary, and thus another leak appears in the system. A similar leak comes from the fear, born of inexperience, that properly to protect, the pots must be lighted considerably in advance of the coming of the killing cold.

It is also a much-mooted query, despite the many reassurances, whether the soot-laden and smoke-covered pollen can continue its fertilization work unhindered, or whether the pollen really does become contaminated from the fires. The doubt about this question has apparently caused a great many others to demur to making the fight with the frost. Probably the greater proportion of the nonsmudgers, however, state simply that "if we can not average paying fruit crops through 10-year periods without artificial protection against the elements, then we are not in a fruit country."

Against the claim in many places that "the man who fired had a full crop, while his neighbor who did not fire had nothing," the counter claim, usually not published, is made that the nonsmudger actually had the better crop; there are also evidences in plenty that men who

have fired "successfully" are now among the ranks of those who do not, and will not, fight frost again with the means and methods now in use. Still, one more reason for not fighting frost is presented in many places, and that is that the period of safety in the buds has not been satisfactorily settled, for, it is claimed, some buds may withstand a temperature of 26° in safety, while others on the same tree may be killed at 31°; and this question, unanswered satisfactorily to many fruit growers, has kept them from the "firing ranks."

The segregated locations of the orchards in the State, and the varying conditions in the more closely compacted fruit-growing communities up and down the air drainage slopes, presenting varying stages of development and progress in the fruit, are two reasons why community or neighborhood firing can not obtain very generally here. And the lone grower on the slope who has prepared to fire is often finally dissuaded because his neighbors will not assist him to "heat all outdoors." In many cases in Utah the grower, heating his orchard alone, has concluded it does not pay, as he watched the heat and smoke from his fires sweep down into the valley away from his orchard on a 15 or 20 mile mountain breeze, rendering his smoke and heat blanket quite ineffective over his own trees.

Another thing that deters many fruit growers from firing is the very intricacy of the problem, when conducted along strictly scientific lines. To study the air drainage of the orchard, map it for temperature pockets and windy ridges, danger zones and safety belts, then distribute pots, and fire accordingly, after making a careful study of the horticultural problems involved, and make all purchases (with the "profits" of a crop not yet borne), and manage all affairs in connection with the work, is, unfortunately, too tangled a matter for many an intelligent grower.

But, assuming the figures hereinbefore presented to be the basis for calculating all legitimate charges against the cost of frost fighting in Utah, the next query is, "How often could we have fired safely in the past; how often would we have failed; and what would it have cost?" for figures of the past weather are the only possible guide to what the future weather will be.

In an endeavor to furnish the reply to this query, in a general way, the following figures have been taken from the records of the weather, kept by cooperative observers of the United States Weather Bureau, with standard pattern instruments, at Corinne, Boxelder County, and Provo, Utah County, each representing large orchard districts. The mornings on which minimum temperatures fell below 30° are counted from April 10, the probable average date of frost danger to fruit; though if the previous few weeks were warm an earlier date has been used, and if the previous weather was cold a later date has been used. The table showing the cost of firing will be remembered in examining these tables.

*Periods of frost damage in the past.*

CORINNE.

- 1897. Firing would have been necessary 1 night, with 29° minimum, therefore the cost would have been 60 cents per acre.
- 1898. No damaging temperatures occurred.
- 1899. Firing would have been necessary 14 nights, making a total cost of \$23.20 per acre for that year.
- 1900. No damaging temperatures occurred.
- 1901. Firing would have been necessary 2 nights; total cost, \$2.40 per acre.
- 1902. Firing would have been necessary 4 nights; total cost, \$4.40 per acre.
- 1903. Firing would have been necessary 6 times; total cost, \$12 per acre.

- 1904. No damaging temperatures occurred.
- 1905. Firing would have been necessary once; total cost, \$1.80 per acre.
- 1906. Firing would have been necessary once; total cost, \$1 per acre.
- 1907. Firing would have been necessary 4 times; total cost, \$3.60 per acre.
- 1908. Firing would have been necessary 5 times; total cost, \$3.80 per acre.
- 1909. Firing would have been necessary 9 times; total cost, \$15 per acre.
- 1910. Firing would have been necessary twice; total cost, \$2 per acre.
- 1911. Firing would have been necessary 15 times; total cost, \$32.20 per acre.

PROVO.

- 1898. Firing would have been necessary twice; total cost, \$2 per acre.
- 1899. Firing would have been necessary 4 times; total cost, \$4.40 per acre.
- 1900. Firing would have been necessary 4 times; total cost, \$3.60 per acre.
- 1901. Firing would have been necessary once; total cost, \$1.40 per acre.
- 1902. Firing would have been necessary 4 times; total cost, \$4.80 per acre.
- 1903. Firing would have been necessary twice; total cost, \$2.40 per acre.
- 1904. Firing would have been necessary twice; total cost, \$2.80 per acre.
- 1905. No damaging temperatures occurred.
- 1906. Firing would have been necessary once; cost, \$1.40 per acre.
- 1907. Firing would have been necessary 5 times; total cost, \$7 per acre.
- 1908. Firing would have been necessary 4 times; total cost, \$6 per acre.
- 1909. Firing would have been necessary 8 times; total cost, \$14.40 per acre.
- 1910. Firing would have been necessary 3 times; total cost, \$7 per acre.
- 1911. Firing necessary 3 times before the fruit was lost; total cost, \$10.20 per acre, and the crop was lost.

**WHY THE SNOW SLIDES FROM THE MOUNTAIN SLOPES.**

By J. CECIL ALTER, observer, U. S. Weather Bureau.

Snowslides and avalanches of various dimensions are quite common in the Wasatch Mountains during warm periods in winter and in the early springtime; and while it is quite apparent that when the weight of snow becomes very great on a steep slope the whole mass will be easily forced from its footing, the reason is not nearly so plausible why a broad expanse of snow having a uniform depth that has lain in apparent safety several weeks after falling will, under certain conditions of weather or internal texture, become so delicately poised that the flutter of a bird on its surface, or, as has been said, even an echo, will send several acres and thousands of tons of snow on a devastating journey down the mountain side.

From general observations it is apparent that the depth of the deposit, in itself, has very little to do with its stability or its tendency to cling to the mountain surface, for, while we hear mostly of the slides in the deeper snows, there are ample evidences that snow layers even less than a foot thick have slid from where they were originally deposited and become scattered along the lower slopes. A slide of this kind is seldom dangerous, and it is only when one inadvertently walks out on such a soft mass with web snowshoes that there is any particular danger. However, on less than a 40° slope (40° from the horizontal) and where the soil underneath is frozen, there is practically no danger of a slide even if the snow layer is 2 feet deep.

It will not be forgotten by the snowshoe mountain climber, however, that when the snow layer, even on a frozen slope of only 40°, is 3, 5, or 7 feet deep, there is probably a sharp demarcation surface somewhere in the mass, separating two falls of snow, and if the lower layer had its surface frozen before the upper layer was deposited there is grave danger of a slide of the upper layer along